DOCUMENT RESUME

ED 429 213 CE 078 461

AUTHOR Zanella, Deborah J.
TITLE Development of a Questionnaire To Survey Graduates of the Electrical Systems Specialization in the Industrial Technology Department (Revised).
PUB DATE 1999-04-00
NOTE 43p.; Ed.D. Practicum, Nova Southeastern University.
PUB TYPE Dissertations/Theses - Practicum Papers (043)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Electrical Systems; Evaluation Criteria; Formative Evaluation; *Graduate Surveys; Higher Education; Literature Reviews; *Material Development; Pilot Projects; Questionnaires; *Technical Education; *Technology Education

ABSTRACT

A questionnaire was developed to survey recent graduates of the electrical systems specialization in the Industrial Technology program at the Central Connecticut State University (CCSU) School of Technology. First, the pertinent literature was reviewed and a formative committee consisting of CCSU faculty and staff and the board of trustees of Connecticut State University was established to identify criteria for developing reliable and valid questions. A draft questionnaire was developed and pilot tested with five graduates of the electrical systems program. Next, the questionnaire was revised based on the formative committee's evaluation and the pilot study's results. The final questionnaire consisted of 26 questions soliciting the following information: students' employment during and after college; graduates' use of certain general skills in their job; extent to which their education contributed to development of those skills; helpfulness of each of the required core and technical courses in the electrical systems curriculum in obtaining a job and succeeding in it; graduates' overall satisfaction with the electrical systems program and its faculty, curriculum, and facilities. (The paper contains 23 references. Appended are the following: 20 criteria for evaluating the questionnaire's appearance, ease of completion, and questions; cover letter to accompany the questionnaire; and questionnaire.) (MN)

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ED 429 213

# DEVELOPMENT OF A QUESTIONNAIRE TO SURVEY GRADUATES OF THE ELECTRICAL SYSTEMS SPECIALIZATION IN THE INDUSTRIAL TECHNOLOGY DEPARTMENT

Deborah J. Zanella

Central Connecticut State University

A practicum report presented to Programs for Higher Education

in partial fulfillment of the requirements for the

degree of Doctor of Education

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DEVELOPMENT OF A QUESTIONNAIRE TO SURVEY GRADUATES OF THE ELECTRICAL SYSTEMS SPECIALIZATION IN THE INDUSTRIAL TECHNOLOGY DEPARTMENT

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Deborah J. Zanella

Revised April 1999

The purpose of the study was to develop a questionnaire to survey recent graduates of the Electrical Systems specialization in the Industrial Technology (IT) program within the School of Technology at Central Connecticut State University (CCSU). The problem was that the extent to which recent graduates of CCSU's Electrical Systems program secure and maintain employment in technical-managerial positions, and the extent to which they attribute their current employment to their educational program at CCSU were unknown.

There are two central research questions for this study: (1) "What specific questions should be included in the questionnaire for graduates to determine their assessment of the Electrical Systems curriculum, their employment status, and the perceived contribution of the program to their employment?" and, (2) "What is the appropriate design of this questionnaire for Electrical Systems graduates?"

The content and design of the questionnaire were determined from a review of literature, sample questionnaires from other universities, and input from the formative committee. A pilot

study was conducted with a small number of students to test the questionnaire's ease of use and validity. The final draft was reviewed by a summative committee for face validation purposes, using criteria approved by the formative committee. The final revised product was submitted to the Dean of the School of Technology.

A significant conclusion from this practicum is that information on students' perceptions of the Electrical Systems program and its value in accomplishing their education and employment goals can provide valuable feedback for evaluating and revising the program. The content and design of a mailed questionnaire appropriate for graduates of the IT program can be determined from the literature review and the practicum process.

It is recommended that the questionnaire be administered by the IT department to all graduates of the Electrical System specialization over the last 5 years. The questionnaire should be one component of a more extensive program review and evaluation conducted by the IT department and supported by the School of Technology.

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# Chapter 1

# INTRODUCTION

## Background and Significance

Central Connecticut State University (CCSU) is a public, metropolitan university located in the Greater Hartford area. The Electrical Systems specialization in the Industrial Technology (IT) program within the School of Technology was established in 1972, before the creation of the School of Technology. The IT-Electrical Systems is a technical program designed to provide students with technical skills and knowledge that will prepare them for employment as technical managers. Graduates are employed in a wide variety of jobs in the industrial and technological marketplace due to the broad nature of the IT degree. Since 1989, the industrial base in Connecticut has changed substantially. It had not been determined if these changes necessitate modification of the Electrical Systems program. A technology curriculum must be dynamic rather than static. Therefore, the school must keep abreast of industry needs and modify curriculums to meet the changing need. The employment success of graduates of the School of Technology is essential for the continued survival of the school.

## Nature of the Problem

Students and employers are two major stakeholders in the Electrical Systems specialization. Increasingly, students demand that education be relevant to employment. Likewise, employers turn to institutions of higher learning to provide them with highly skilled, technical workers. The globalization of the marketplace and the development of new technologies, as well as the decline of traditional manufacturing, have changed the needs of industry in Connecticut. However, the extent to which recent graduates of the Electrical Systems program secure and maintain employment in technical-managerial positions, and the extent to

which they attribute their current employment to their educational program at CCSU were unknown. The problem was that no assessment had been done on how well the existing program met the employment needs of graduates.

## Purpose of the Study

The purpose of the study was to develop a questionnaire to survey recent graduates of the Electrical Systems specialization. This questionnaire was designed to determine graduates' satisfaction with the program curriculum and the degree to which they perceive that their education was relevant to employment in a technical-managerial position in industry.

## Relationship to Seminar

This practicum is directly related to the Emergence of Higher Education in America Seminar. This seminar focuses on the historical and philosophical roots of higher education. Topics covered include the European heritage of American higher education, the evolution and diversity of American higher education, the current dynamic nature and the future of higher education. Initially, higher education was viewed as a social investment, however, by the late nineteenth century the goals had expanded to include serving individual needs. The debate between the goal of social investment and that of individual need parallels the controversy between liberal education and vocational education. The Morrill Act of 1862 paved the way for vocational-technical education at the postsecondary level. A central goal of this education is to provide graduates with the skills and knowledge necessary to become gainfully employed. Examining the employment outcomes of a four-year, technology program is an assessment of the program's success in meeting that goal.

## Research Questions

There were two research questions for this study. The first research question was "What specific questions should be included in the questionnaire for graduates to determine their assessment of the Electrical Systems curriculum, their employment status, and the perceived contribution of the program to their employment?" The second research question was "What is the appropriate design of this questionnaire for Electrical Systems graduates?"

## Definition of Terms

For the purposes of this practicum, the following terms needed clarification.

Technical Manager. A person in this position manages technical supervisors or workers.

Industrial Technology. This is an educational program that includes management courses as well as courses in a selected technical specialization.

Graduate. A person who has successfully completed a degree program. The term is used interchangeably with the word alumni.

Questionnaire. An instrument for collecting information from individuals sometimes called a survey.

# Chapter 2

# REVIEW OF THE LITERATURE

## Introduction

A careful review of the literature was completed to provide the conceptual foundation for developing a questionnaire for program graduates. The primary source for the review was the Educational Resources Information Center (ERIC). Specific materials reviewed included alumni and graduate survey tools from numerous associate and baccalaureate degree granting institutions, Electrical Systems program description and curriculum requirements, and course materials that reference the program goals and objectives.

A number of questions related to the two research questions drove the search. First, what is the value of feedback from program graduates or alumni? Second, what specific questions should be included in the questionnaire for graduates to determine the effectiveness of the Electrical Systems curriculum, and the perceived contribution of the program to their employment? Third, how are questions constructed to be reliable and valid? Finally, what is the appropriate design of the questionnaire?

## Value of Graduate Feedback

For years, the business world has used consumer feedback to improve products and services. Increasingly, higher education institutions are tracking students after graduation as part of the institutional planning and evaluation process. According to Haugen and Dallam (1992, p. 134), the accountability issue has recently focused on assessment of measurable outcomes such as job placement, career advancement, personal development and intellectual development. Information on students' perceptions of the school and its value in accomplishing their education

and employment goals provides valuable feedback at the program, campus and state levels (Frank, 1991, p. v). Hunziker (1991) stresses the value of alumni feedback.

> The opinions and outcomes of alumni serve as important measures of an institution's success in meeting the needs and goals of its undergraduates and providing them a high quality education. In particular, recent alumni share a common perspective from which to evaluate their educational experiences . . . . They are well positioned to judge the degree to which they have been prepared by their educational experiences to perform new activities and assume greater responsibilities. (p. 1)

Outcome assessment is being used by institutions to justify program effectiveness. "Deans, department chairs, and faculty are requesting this type of information to enable them to plan curricular revision and development that will prepare their students to fit satisfactorily into today's societal requirements" (Haugen & Dallam, 1992, p. 134). In addition to guiding program review and revision, alumni feedback is employed in recruitment and marketing strategies, enrollment management, administrative decision making, and career planning by students.

Recognizing that the majority of freshmen entering college do so to prepare for a career, it behooves institutions of higher education to assess the job they are doing in preparing their graduates for employment. "A survey program that periodically asks graduates and their employers about the job preparation the graduates have received from the institution can play a vital role in providing feedback for improvement that a quality-conscious institution demands" (Banta, 1993, p. 1).

## Content of Questionnaire

Colleges and universities have collected data on career and educational outcomes for some time. Most institutions regularly send out short questionnaires to ascertain graduates'

employment status, salaries, and further education. There are standardized alumni surveys such as the American College Testing (ACT) which addresses demographic information, continuation of education, employment history, and college experiences (Pettit, 1991, p. 5; Haugen & Dallam, 1992, p. 134). An examination of several alumni survey instruments identifies a number of common themes incorporated in the surveys. Hunziker (1991, p. 3) lists four goals of the graduate survey for the University of California at Davis. The four key areas are: the pursuit of further education, employment outcomes, undergraduate preparation for both advance study and work, and alumni satisfaction with key aspects of the institutions academic and social environment. Phipps and Romesburg (1988, p. 284) identify questions related to the quality of educational experience, relationship of the education to employment, preparation provided for occupation, and the benefit of the college education. Satterlee (1992, p. 19) lists frequently used evaluation criteria for assessing institutional effectiveness according to the Southern Association of Colleges and Schools (SACS). They include student perception of their development toward educational objectives, student affective development, student opinions of program quality, and job placement rates.

Johnson County Community College uses a follow-up survey of graduates as one component of its institution effectiveness assessment program (Conklin, 1990, p. 5). New questions were designed to measure individual educational goal achievement, self-reported cognitive and non-cognitive outcomes, and career progress, as well as employment success, student satisfaction with their college experience, student perception of the quality of the institution, and student knowledge and skills. The community colleges in Maryland use a common survey statewide. The survey measures goals, goal achievement, personal development, transfer success, student satisfaction, and current employment and education status and

experiences (Frank, 1991, p. B1; Hagerstown Junior College, 1993, p. iii; O'Grady, 1990, p. 124). Similarly, surveys used by community colleges in other states address the purpose for attending college, goal achievement, perceptions of college education, and rating of the quality of the college, instruction, services, and programs (Montemayor, 1986, p. 4; Oklahoma City Community College, 1992, p. 8; Arrowhead Community College, 1993, p. A1). There are questions directed at discerning the relationship between the educational program and subsequent employment (Yee, 1993, p. A1-6). "How well did their education prepare them for their job?" and "How useful was their education on the job?" are commonly asked questions in graduate surveys.

## Questionnaire Development

Extensive material exists concerning questionnaire development, design, and implementation because the questionnaire is the most often used instrument in survey research. As Sheatsley (1983, p. 195) points out it is simply one standardized tool employed in social research surveying, and it does not necessarily fit every study. However, the questionnaire is common because it saves time and money. McMillan and Schumacher (1984, p. 140) identify several advantages of the mailed questionnaire. A questionnaire is written for a specific purpose, allows for standardized questions, provides a means to reach distant locations, and assures anonymity. Designing a good questionnaire is still more an art than science despite its popularity (Sheatsley, p. 200). The qualities that determine a good questionnaire relate to its purpose. Purpose falls into three categories: to meet the objective of the research, to obtain the most complete and accurate information possible, and to do this within the time and money limits of the study (Sheatsley, p. 201).

Borg and Gall (1989, p. 423) discuss the major steps of conducting a successful questionnaire survey. The development stage begins with defining the objectives, selecting a

sample, writing items, constructing the questionnaire, and finally pretesting the questionnaire before administering it to the sample. The first step is the most critical. The literature review and focused discussions with subject experts and individuals from the study populations aid the researcher in defining the study objectives (Fowler, 1993, p. 95). Once the objectives are defined and the study sample selected, the next step is to develop the questionnaire content. The mode of administration and the purpose affect the questionnaire design. In addition, the sample affects design. Characteristics of the sample such as age, education, and overall sophistication of the sample should be taken into consideration when developing the questions (Sheatsley, 1983, p. 199).

## Developing the Questionnaire Items

Reliability and validity are of concern in designing questions. Reliability means two respondents under the same conditions should answer the question in the same way. Validity is the extent to which the empirical measure adequately reflects the real meaning of the concept under consideration (Fowler, 1993, p. 70).

Questions measure different types of information, both quantitative and qualitative. Sheatsley (1983, p. 203) discusses how questions can measure a respondent's knowledge of an issue, interest in a problem, attitude toward an issue, reason for an opinion and strength of an opinion. Fowler (1993, p. 80) differentiates questions designed to measure facts or objectively measurable events from questions designed to measure subjective states such as attitudes.

According to McMillan and Schumacher, (1984, p. 143) the structure of questions falls into two broad categories: open-ended and closed-ended. An open-ended question is one that states the question and provides a blank space for the answer, whereas, a closed-ended question provides a limited selection of possible responses from which the respondent must choose. The

responses can be scaled items such as the Likert scale, a list of items to be checked or ranked, or adjective pairs called semantic differentials. Advantages of an open-ended structure are that it allows the respondent to give a more precise response from their own frame of reference and answers are not influenced by suggested alternatives (Fowler, 1993, p. 82; Sheatsley, 1983, p. 206; Foddy, 1992, p. 128). A disadvantage is that open-ended questions can elicit a great deal of repetitious, irrelevant material that often misses the point of the question. They take more time and money to encode. The close-ended approach avoids this problem and has several advantages; the respondent can perform more reliably the task of answering the question when response alternatives are given, the researcher can perform more reliably the task of interpreting an answer when alternatives are given, and there is increased likelihood that there will be enough people in any one category to be analytically interesting. On the other hand, respondents are required to fit their personal response to the provided list of responses. Anticipating all valid responses is one difficulty of designing closed-ended questions (Sheatsley, 1983, p. 207; Foddy, 1992, p. 128).

Questions should be written in simple, precise, and clear language and should be presented in an objective, nondirective manner. Avoid terminology that is embarrassing, demeaning, or threatening. Ask for information the respondents know, appeal to their interest in the subject, and make the questions relevant to the respondent (Babbie, 1990, p. 133; Issac & Michael, 1971, p. 92; Sheatsley, 1983, p. 212-217). These authors discuss common errors made in writing questions. Questions are often too wordy, use advanced vocabulary, are vague or ambiguous, use double negatives, are double barreled (ask more than one question per item), or are one-sided or biased. Many suggestions for avoiding problems are put forward include defining any terms that may be unclear, and minimizing any sense of judgement in the wording.

Fowler (1993, p. 91) suggests that to increase the validity of subjective questions particular attention should be paid to ordinal scales. Such response alternatives should be unidimensional and monotone; that is they should deal with only one property at a time, and be presented in order, without inversion. With ordinal scales or continuums it is better to use more categories not less, within reason.

The question as written should fully prepare a respondent to answer the question. Reliability means the question means the same thing to every respondent and that they answer questions in a similar way. Reliability, as well as validity, is threatened by question design. Fowler (1993, p. 71-79) gives examples of poor questions that do not assure researchers of consistent responses. Incomplete questions such as "age?" or longer questions that elaborate on meaning in parentheses should be avoided. "Why?" questions should be avoided. Difficult words should be eliminated and all ambiguous words, terms, concepts should be defined.

The question is only one side of the interaction. Response choices require as much attention as do questions. Closed-ended response choices should be limited to seven, cover mutually exclusive categories, have equal number of responses on either side of a middle position (balanced), and be all inclusive (Babbie, 1990, p. 128). The neutral alternative is often omitted because the don't know/don't care response is often seen as the lazy, easy way out. It is common to use a response matrix which is the same set of response alternatives (ie. Likert scale) for several questions. A matrix increases the comparability of responses for the respondent as well as the researcher. However, the use of a matrix should be limited to eight to 10 items to avoid boredom and a response mind set. Respondents may agree with all statements because they agreed with the first several (Babbie, p. 140).

## Designing the Questionnaire

Once the questions are developed the questionnaire still must be designed. Important considerations include the ordering and formatting of questions, wording of instructions, overall appearance, and a cover letter. The overall presentation of the questionnaire is important (McMillan & Schumacher, 1984, p. 142, Babbie, 1990, p. 140-145). The tool should look professional, therefore, the grammar, spelling, and punctuation must be correct. Reproduction should be professionally done so that the printing is clear and easy to read. Leave plenty of white space on the page to avoid a cluttered appearance. Keep the overall length as short as possible while still being adequate. Layout questions in a logical sequence, grouping related items together. The more important items should be placed first in a long survey and demographical questions at the end. However, be aware that the position and sequence of items may affect response. Clearly number all items and pages. Use examples if items are difficult to understand. Avoid lengthy instructions; make them brief and easy to understand.

The literature emphasizes the value of pretesting. Sheatsley (1983, p. 225) recommends pretesting the questionnaire using a sample of 12 to 25 individuals, not known to the researcher, who reflect the study population. The researcher can determine the amount of time it takes to complete the survey, problems with instruction and question wording, and respondents' reactions to the questionnaire. Any major changes must be pretested again.

The mailed questionnaire should be accompanied by a cover letter to elicit the maximum number of returns (Isaac & Michael, 1971, p. 94). The cover letter should be clear, brief, and give an adequate statement of the purpose and value of the study. The literature (McMillan & Schumacher, 1984, p. 163; Isaac & Michael, p. 95) provides ample instruction in constructing a

successful cover letter. The mailed questionnaire should include a stamped self-addressed return envelope, some type of incentive such as a trinket or dollar bill, and an offer to send a summary of the study results.

## Summary

Considered as a whole, this literature review provides a framework for the development of a questionnaire for graduates of an academic program such as the Electrical Systems program at CCSU. It is clear that feedback from program graduates is valuable in program review and revision. Samples of graduate questionnaires aided in the selection of specific questions to include in the questionnaire. The literature provided guidelines for the development of reliable and valid questions, as well as the design of the questionnaire itself.

# Chapter 3

## METHODOLOGY AND PROCEDURES

An extended literature search provided the conceptual framework for the developmental practicum. First, a review of the literature on alumni questionnaire content and questionnaire design was conducted. The review included theoretical and applied topics of questionnaire development and design, as well as identification of components to be included in a survey questionnaire used for curriculum evaluation purposes. The primary source for the review was ERIC. Specific materials reviewed included alumni and graduate survey tools from numerous associate and baccalaureate degree granting institutions, Electrical Systems program description and curriculum requirements, and course materials that reference the program goals and objectives.

Second, the criteria were established for the questionnaire design and content (see Appendix A). The criteria were based on the information gleaned from the literature review and input from the formative committee. The formative committee consisted of faculty and staff from CCSU and the Board of Trustees of Connecticut State University (CSU). It included one professor from the School of Technology, the Coordinator of Student Administration and Advising in the School of Business, and a member of the CSU Office of Institutional Research and Planning.

Members of the formative committee were consulted individually during the design process leading up to the first draft of the questionnaire. The first draft was mailed to the formative committee, prior to the committee meeting to discuss the questionnaire and make recommendations for revision. The questionnaire was revised based on the formative committee's

feedback and a revised draft of the questionnaire was mailed to the committee. The formative committee evaluated this draft according to the criteria.

A pilot study was conducted with 5 graduates to test the questionnaire's ease of use and validity. The students completed the questionnaire in the presence of the researcher so that immediate feedback could be obtained. The author took notes of each subjects comments and questions, noting any ambiguities, confusions, and omitted responses. The questionnaire was again revised based on the formative committees' evaluation and the results of the pilot study.

The summative committee validated the criteria. This committee consisted of the chairperson of the IT Department, the Associate Dean in the School of Technology and the Dean of the School of Technology. The draft of the questionnaire and the cover letter (see Appendix B) were reviewed by a summative committee for face validation purposes, using the criteria approved by the formative committee.

The final revised product was submitted to the Dean of the School of Technology (see Appendix C). The approved questionnaire is printed on one side of 81/2 by 11 inch, plain white paper. It is seven pages long with 27 questions. The first page solicits information on students' employment during and after college. This is followed by a couple of questions designed to measure how often graduates use certain general skills on the job, and how much their education contributed to the development of these skills. Two questions list all the required core and technical courses of the Electrical Systems curriculum and ask if these courses were helpful in obtaining a job, and if they are useful in the graduates' current jobs. Graduates are asked to rate the faculty, curriculum, and facilities of the Electrical Systems program, as well as to state their satisfaction with the program as a whole. Question 26 is long and lists approximately eight skills as learning objectives for each course. Respondents are asked to indicate the importance of each

skill in their career, and their proficiency in the skill before and after taking the courses. The final question is an open-ended one requesting input on topics or skills that the graduate thinks should be included in the program.

## Assumptions

For this practicum, it was assumed that members of the formative committee had the expertise to guide the development of this project. It was assumed that current theory on questionnaire design and development was the most appropriate and useful for this project. It was also assumed that content areas for an alumni questionnaire for curriculum evaluation would be identified from the literature review. The use of similar student questionnaires from other institutions for design guidelines was assumed appropriate. It was further assumed that the summative committee's evaluation of the content and format was valid.

## Limitations

The product was limited in that it was specific to the needs of the Electrical Systems specialization in the IT Department at CCSU. The questionnaire design was constrained by practical requirements of cost, size, and ease of response. The resulting questionnaire was as comprehensive and complete as possible while still not being too expensive to duplicate and mail, nor too long to complete.

# Chapter 4

## RESULTS

The results of the design process supported by the literature review, guided by the formative committee, refined through a pilot study, and validated by the summative committee was a questionnaire for graduates of the Electrical Systems specialization (see Appendix C). The review of literature directed the development of the first draft of the questionnaire. Ample references, including the classics Handbook of survey research edited by Rossi, Wright, and Anderson (1983), Educational research: An introduction by Borg and Gall (1989), Handbook in Research and Evaluation by Isaac and Michael, and McMillan and Schumacher's Research In Education: A Conceptual Introduction were used to guide the development of a mailed questionnaire and the questionnaire items. Twenty-one references are cited in the literature review.

The literature stressed the value of feedback from graduates as part of the institutional planning and evaluation process by institutions of higher education. Clearly, employment is one important outcome of higher education for students. Surveying program graduates to assess the job preparation they received from the institution can provide valuable information for program review and revision.

Several graduate or alumni questionnaires and surveys from associate and baccalaureate degree granting institutions were reviewed. These included instruments from Maryland community colleges, Oklahoma City Community College, San Francisco State University, Hagerstown Junior College, and Mesa Community College, among others. The questions about employment with an IT degree were modeled after similar questions used by the IT Department at

East Carolina University. A questionnaire for the Lesley College School of Management provided the basis for the proficiency scale in question 26 (Poirier, 1995, p. 42).

A formative committee was formed to guide the questionnaire design. The committee consisted of one professor from the School of Technology, the Coordinator of Student Administration and Advising in the School of Business, and a member of the CSU Office of Institutional Research and Planning. The members were asked to participate in this practicum process by the author. Due to scheduling difficulties, the members were consulted individually during the development of the first draft. Suggestions were taken for the evaluation criteria concerning the questionnaire design and content. A list of criteria was created and sent to the formative committee. The list was reviewed and accepted without revisions (see Appendix A).

Discussions with members of the formative committee helped clarify the objectives of the questionnaire. The purpose of the questionnaire was to assess graduates' satisfaction with the program and the degree to which they perceive that their education was relevant to employment in a technical-managerial position in industry. The intent was to obtain accurate and reliable information which will be useful in assessing the value of the Electrical Systems program to its graduates. The major decisions to be made from information gleaned from the questionnaire responses include the following:

1. to add or delete required courses in Electrical Systems.
2. to modify course content of Electrical courses
3. to improve the learning process for students through curriculum adjustments, faculty training, or improving facilities.

Two questions identified the information required to make these decisions. The first question was, "Did the IT degree in Electrical Systems help graduates to obtain and/or maintain

employment in a technical-managerial position?" The second question was "How satisfied are graduates with the overall program, curriculum, faculty and facilities in the Electrical Systems program?" These questions guided the design of the questionnaire objectives. The objectives are listed here:

1. to learn what kinds of jobs graduates secure.
2. to identify what skills are required by these jobs.
3. to ascertain if graduates think their jobs required the skills taught by the program.
4. to determine if graduates think the program/degree helped them get their jobs.
5. to determine graduates' satisfaction with the overall IT program.
6. to measure graduates' satisfaction with the curriculum content of the Electrical Systems program.
7. to rate graduates' satisfaction with the Electrical Systems faculty's classroom performance.
8. to identify graduates' satisfaction with the physical facility and equipment used in the Electrical Systems program.
9. to assess graduates' opinion of their proficiency in skill areas taught in the Electrical Systems program.
10. to learn graduates' judgement of their proficiency in Electrical Systems skill areas before and after taking the program.

The first draft of the questionnaire was mailed to the formative committee and a meeting was held to review the questionnaire. The committee made several suggestions for reducing the length of the questionnaire, and rewording questions for clarity. The revised questionnaire was resubmitted to the committee for a final review.

The pilot study pointed out several problems in the questionnaire. A major flaw was detected by respondents who had transferred all the required electrical courses into CCSU. An additional question and a simple statement directing those graduates who had transferred all, or all but one, electrical courses to skip questions 23 through 25 and only complete part (a) of question 26 cleared up the problem. Questions 8 through 14 needed some clarification in order to yield answers based on a current or recent job (if not currently employed). Also, question 21 needed an 'N/A' or 'Didn't use' response choice. Other questions and comments from the pilot study resulted in minor wording changes to questions 4, 7, 18, and 26.

The final draft of the questionnaire was reviewed by the summative committee for validation purposes. The summative committee was formed by the author and consisted of the chairperson of the IT Department, the Associate Dean in the School of Technology and the Dean of the School of Technology. The committee suggested one clarifying instruction which was added prior to question 19. The committee made a strong recommendation that the IT department administer the questionnaire to recent graduates of the Electrical Systems program.

The results of the procedures outlined in the previous chapter answered both research questions. In answer to the first research question, "What specific questions should be included in the questionnaire for graduates to determine their assessment of the Electrical Systems curriculum, their employment status, and the perceived contribution of the program to their employment?", questionnaire objectives were identified. The objectives guided the selection of specific questions.

The results of the procedures also answered the second research question, "What is the appropriate design of this questionnaire for Electrical Systems graduates?" The results established the evaluation criteria for the design of the questionnaire. Appropriate design criteria included the

length of the questionnaire, the amount of time to complete, clarity of questions and directions, a professional appearance, and the expense of duplication and postage. The design of the questions was guided by the evaluation criteria for questions listed in Appendix A.

# Chapter 5

# DISCUSSION, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

## Discussion

The results of this practicum were directly related to the purpose which was to develop a questionnaire to survey graduates of the Electrical Systems specialization in the IT department. The questionnaire was designed to assess graduates' satisfaction with the program and the degree to which they perceive that their education was relevant to employment in a technical-managerial position in industry. The literature review provided guidelines for the design of the questionnaire. The content of the questionnaire was derived from the review of literature, other similar questionnaires, and the identified objectives. Consultations and meetings with the formative and summative committees clarified the content and design of a questionnaire appropriate for graduates of the Electrical Systems specialization in the IT program.

The literature review indicated that institutions of higher education benefit by employing feedback from graduates as part of the institutional planning and evaluation process. The opinions and outcomes of alumni provide important measures of an institution's success in meeting the needs and goals of its graduates and providing them a high quality education. Information on students' perceptions of the school and its value in accomplishing their education and employment goals provides valuable feedback at the program level. The support of the summative committee for the project was based on their belief that such feedback from graduates is of value in measuring the effectiveness of educational programs. There was a recognized need to develop a survey instrument for this purpose.

The questionnaire developed through this practicum process conforms to the guidelines and common practices drawn from the literature review with a couple of exceptions. The length

of the questionnaire and the amount of time required to complete it are long. One member of the formative committee made a strong recommendation to shorten the questionnaire. This issue was discussed with the summative committee, which came to the conclusion that little could be deleted from the questionnaire if it is to meet the objectives described in this report. The consensus was that the questionnaire is going to a select, highly motivated group, therefore, the length should not be a major deterrent to completing it. The only other deviation from the criteria is question 26 which is lengthy and uses the same response scale for a long list of skills in violation of the guideline to limit a matrix to 10 items. The purpose of this rule is to avoid boredom and response mind set where respondents answer all statements the way they answered the first several.

## Conclusions

Several conclusions are drawn from the results of this practicum. Most importantly is the conclusion that information on students' perceptions of the Electrical Systems program, and its value in accomplishing their education and employment goals, provides valuable feedback for evaluating and revising the program. A second conclusion is that a mailed questionnaire is the best way to obtain this information. Questionnaires have advantages and disadvantage, as do all methods of data collection, however, the mailed questionnaire is the most suited for reaching a geographically dispersed group such as the graduates of the Electrical Systems program. The final conclusion is that the content and design of the questionnaire can be determined from the literature review and the practicum process. Both the formative and summative committees contributed to the development of a questionnaire that is useful for the School of Technology.

## Implications

Several implications, related to the stated problem and the purpose of this practicum, are drawn from the conclusions. The Electrical Systems is a technical program designed to provide students with technical skills and knowledge that will prepare them for employment as technical managers. Employment is one significant outcome of the educational program. The extent to which recent graduates of the Electrical Systems program secure employment as technical managers, and the extent to which they attribute their current employment to their educational program are indicators of how well the existing program met the employment needs of graduates. This information can contribute significantly to curricular review and revision.

One proven method for obtaining this information is to solicit it directly from the program graduates since they are in a unique position to judge the impact of their education on their employment. A mailed questionnaire is an appropriate instrument for collecting information from graduates. It is an inexpensive means for reaching a large number of geographically dispersed people. There are sufficient resources available at the university to design customized questionnaires for the various degree programs.

The practicum process resulted in a questionnaire designed to determine graduates' satisfaction with the program curriculum and the degree to which they perceive that their education was relevant to employment in a technical-managerial position in industry. The success of the practicum implies that the development of a similar product is possible for other degree programs in the School of Technology. The usefulness of the information collected from the questionnaire for evaluating and revising the Electrical Systems curriculum will provide the incentive for other programs to conduct similar studies.

## Recommendations

It is recommended that the questionnaire developed in this practicum be administered by the IT department to all graduates of the Electrical System specialization over the last 5 years to determine their employment status and how much they credit their current position to their education in the program. Feedback from graduates will be valuable for assessing the success of the Electrical System specialization in achieving its objective of meeting the employment needs of industry. However, if the positions held by graduates are not technical management positions, or if graduates express real dissatisfaction with the program, further investigation into industry need and program evaluation may be warranted. All the programs within the School of Technology could reap similar benefits from graduates' feedback. Therefore, a second recommendation is that the questionnaire be used as a model by other programs within the School of Technology.

The questionnaire should be one component of a more extensive program review and evaluation conducted by the department and supported by the School of Technology. These efforts should include industry analysis, employer survey, and review of other IT degree programs nationally. Program review and evaluation is consistent with the IT department's strategic plan goal to maintain contemporary and relevant curricula. It is essential for the technology programs at CCSU to be reviewed and modified regularly to ensure up-to-date and relevant content. The quality of these programs directly impact employment success of the graduates. If the program does not meet the employment needs of our graduates, adequate future enrollments will be threatened.

REFERENCES

Arrowhead Community College. (1993). The five-year follow-up report: A survey of 1986-1987 graduates. Grand Rapids, MN (ERIC Document Reproduction Service No. ED 358 902)

Babbie, E. (1990). Survey research methods. (2nd ed.) Belmont, CA: Wadsworth Publishing Co.

Banta, T. (1993). Critique of a method for surveying employers. Tallahassee, FL: Florida State University (ERIC Document Reproduction Service No. ED 355 895)

Borg, W. R., & Gall, M. D. (1989). Educational research: An introduction. (5th ed.). New York, New York: Longman.

Conklin, K. A. (1990). Assessment of institutional effectiveness: Career student outcomes. AIR 1990 Annual Forum paper. Louisville, KY (ERIC Document Reproduction Service No. ED 321 698)

East Carolina University. (1994). Department of Industrial Technology. Greenville, NC.

Foddy, W. (1992). Constructing questions for interviews and questionnaires: Theory and practice in social research. Cambridge, UK: Cambridge University Press.

Fowler, F. J., Jr. (1993). Survey research methods. (2nd ed.). Newbury Park, CA: Sage Publications.

Frank, J. M. (1991). A comparative analysis of 1990 Graduates. Columbia, MD: Howard Community College (ERIC Document Reproduction Service No. ED 338 284)

Hagerstown Junior College. (1993). Follow-up of 1992 graduates. Hagerstown, MD (ERIC Document Reproduction Service No. ED 362 240)

Haugen, C. & Dallam, J. (1992). Ask a person who owns one: Using alumni opinions in enrollment management. College and University. 133-143.

Hunziker, C. M. (1991). 1989-90 graduates of UC Davis: Their postgraduate studies, occupations and impressions. Davis, CA: California University at Davis (ERIC Document Reproduction Service No. ED 341 349)

Isaac, S., & Michael, W. B. (1971). Handbook in research and evaluation. San Diego, CA: EDITS Robert R. Knapp.

McMillan, J. H., & Schumacher, S. (1984). Research in education: A conceptual introduction. Boston: Little, Brown and Company.

Montemayor, J. J. and others. (1986). Graduate follow-up survey report, Spring 1986. Mesa Community College, Mesa, AZ (ERIC Document Reproduction Service No. ED 280 514)

O'Grady, L. T. (1990). Results of the 1988 graduate follow-up survey and graduate employer survey. Anne Arundel Community College. Arnold, MD (ERIC Document Reproduction Service No. ED 318 510)

Oklahoma City Community College. (1992). Information from 1989 and 1990 Oklahoma City Community College graduates. Oklahoma City, OK (ERIC Document Reproduction Service No. ED 344 649)

Pettit, J. (1991). Listening to your alumni: One way to assess academic outcomes. Association for Institutional Research. Tallahassee, FL (ERIC Document Reproduction Service No. ED 337 098)

Phipps, R. A. & Romesburg, K. D. (1988). An assessment by alumni of college and university experience. College and University. 284-295.

Poirier, J. (1995). Evaluation of a Master of science degree program in training and development at Lesley College School of Management. Nova Southeastern Practicum.

Satterlee, B. (1992). Program review and evaluation: A survey of contemporary literature. (ERIC Document Reproduction Service No. ED 356 261)

Sheatsley, P. B. (1983). Questionnaire construction and item writing. In P. H. Rossi, J. D. Wright, & A. B. Anderson (Eds.), Handbook of survey research (pp. 195-230). Orlando, FL: Academic Press, Inc.

Yee, D. (1993). Report on the development and evaluation of the "Survey of undergraduate alumni" and the "Survey of graduate alumni" in health education at San Francisco State University. San Francisco, CA (ERIC Document Reproduction Service No. ED 372 102)

# APPENDIXES

Appendix A

Criteria for Evaluating the Questionnaire

**Appearance**

1. professional
2. easy on the eye

**Ease of Completion**

3. reasonable length
4. takes reasonable amount of time to complete
5. questions are clear
6. directions are clear

**Questions**

7. language is clear, precise and simple
8. close-ended responses are exhaustive
9. responses are objective
10. not threatening
11. no bias wording
12. scales are unidimensional and monotone
13. matrix limited to 10 items
14. scales are limited to 7
15. scales are mutually exclusive, balanced and all inclusive
16. no double barrel or double negative questions
17. ask for useful information
18. respondents likely to know answers
19. are valid
20. are reliable

Appendix B

Cover Letter

Dear *Graduate's name*,

The attached questionnaire is specific to the Electrical Systems program in the Industrial Technology Department at CCSU. The Department is reevaluating the curriculum to make revisions necessary to ensure that the program meets current job market needs. The information from this questionnaire will provide important information about the value of the Electrical Systems program to your career success.

Your input is critical because you are in the unique position of knowing the Electrical Systems program and the current job market. The IT degree is designed to prepare individuals to become technical managers in electrical or electronic fields. The department would like to know how well we have done our job of providing an appropriate education to assist you in attaining your career goals.

This is the first time we have attempted to gather this much information from graduates of the Electrical Systems program. We recognize that the questionnaire is long and takes about a half hour to complete. Still it is the best means we have available to determine the effectiveness of the program, so we want to stress the importance of your response.

It will be greatly appreciated if you will complete the questionnaire and return it in the stamped, pre-addressed return envelope enclosed by '*specific date*'. We realize that you may not be currently employed in a technical managerial position. However, your input is still very important to the success of the study. Please accept the enclosed CCSU decal as a sign of our appreciation for your time and effort. Thank you.

Sincerely yours,

_____

William W. Davison
Chairperson, Industrial Technology Department

_____

Deborah J. Zanella
Assistant Professor, Electrical Systems

Appendix C

Questionnaire Final Product

Name: _____
Street: _____
City: _____ State: _____ ZIP: _____
Home Phone: (____)-_____-_____
Social Security # _____-_____-_____

1. What year did you receive your BS degree in Industrial Technology from CCSU? _____
2. The majority of the time you were at CCSU were you: _____ part-time _____ full-time
3. Did you co-op? _____ Yes _____ No
4. Did you do an internship? _____ Yes _____ No (requirement waived, course work used for credits)

5. Your internship was in a: _____ Job already had _____ New job _____ Not Applicable

6. Did your co-op or internship job lead to a regular job with the same company?
_____ No _____ Yes _____ Not Applicable

7. Are you: _____ Employed full-time _____ Employed part-time _____ Not employed by choice
_____ Employed part-time but seeking full-time _____ Not currently employed but seeking employment

Please answer questions 8 through 14 based on your current or most recent job.

8. Do you consider your BS degree to be related to your job responsibilities:
_____ Significantly _____ Somewhat _____ Very little

9. Please give employer information:
Company name: _____
Address: _____
_____
Your job title: _____
Primary product or service at your location? _____

10. Please indicate your current annual salary range:
_____ Under $19,999 _____ $20,000-29,999 _____ $30,000-39,999 _____ over $40,000

11. What percentage of your present job responsibilities is technical?
_____ 100% _____ 75% _____ 50% _____ 25% _____ Other _____%

12. What percentage of your present job responsibilities is managerial?
_____ 100% _____ 75% _____ 50% _____ 25% _____ Other _____%

13. Which of the following occupational categories best describes your current position?
____ Management ____ Supervision ____ Quality Assurance ____ Sales/Marketing ____ R & D
____ Maintenance ____ Technical Support ____ Training /Education ____ Design ____ Other (specify) ____

14. Please provide a brief description of your current job including your major responsibilities.
_____
_____
_____

15. After completing the IT degree, how long did you look for work before obtaining your first job related to the degree?
_____ Had a job which continued after I graduated _____ Less than 6 months _____ 6 to 12 months
_____ Obtained a job prior to graduation _____ 13 to 24 months _____ More than 2 years

16. What was your primary activity in your first job after completing the IT degree?
____ Management ____ Supervision ____ Quality Assurance ____ Sales/Marketing ____ R & D
____ Maintenance ____ Technical Support ____ Training /Education ____ Design ____ Other (specify) _____

17. How often on a **daily** basis do you perform the following in your job? (check one box for each skill)

| Skill | Several Times | A Few Times | Seldom | Never | Skill | Several Times | A Few Times | Seldom | Never |
|---|---|---|---|---|---|---|---|---|---|
| Verbal communications | | | | | Use of management skills | | | | |
| Written communications | | | | | Use of human relations skills | | | | |
| Mathematic skills | | | | | Use of technical skills | | | | |
| Use of problem solving skills | | | | | Use of computer skills | | | | |

18. How much did your education at CCSU contribute to your development in the following areas:
Please circle one number for each item.

| | Significantly | Moderately | Somewhat | Not at all |
|---|---|---|---|---|
| Increased my knowledge of electrical circuits and components | 4 | 3 | 2 | 1 |
| Improved my writing ability | 4 | 3 | 2 | 1 |
| Increased my ability to use mathematics | 4 | 3 | 2 | 1 |
| Improved my organizational skills | 4 | 3 | 2 | 1 |
| Aided my verbal communication skills | 4 | 3 | 2 | 1 |
| Fostered the development of my problem solving skills | 4 | 3 | 2 | 1 |
| Enhanced my computer skills | 4 | 3 | 2 | 1 |

19. How satisfied were you with the Industrial Technology Program at CCSU? Remember to think of the program as a whole.
Please circle one number for each item.

| | Very satisfied | Satisfied | Dissatisfied | Very dissatisfied | Did not use |
|---|---|---|---|---|---|
| With the overall program | 4 | 3 | 2 | 1 | 0 |
| Fixed curriculum | 4 | 3 | 2 | 1 | 0 |
| Electives | 4 | 3 | 2 | 1 | 0 |
| Class scheduling | 4 | 3 | 2 | 1 | 0 |
| Academic advising | 4 | 3 | 2 | 1 | 0 |
| Mentoring and tutoring services | 4 | 3 | 2 | 1 | 0 |

PLEASE IN THE FOLLOWING QUESTIONS ONLY RESPOND FOR THE COURSES WHICH YOU HAD AT CCSU.

20. The following are core courses in Industrial Technology.
    a. Please check those courses which you had at CCSU.
    b. In the second column place a check next to courses that were helpful for obtaining a job or promotion.
    c. In the third column place a check next to courses that are useful in your current job.
    d. In the fourth column place a check next to the single course which is the **MOST** valuable to you.
    e. In the fourth column place a check next to the single course which is the **LEAST** valuable to you.

| | Course Title | Had at CCSU | Helpful for obtaining a job | Useful in current job | **MOST** valuable Check 1 in group | **LEAST** valuable Check 1 in group |
|---|---|---|---|---|---|---|
| IT 362 | Leadership Skills | | | | | |
| IT 410 | Industrial Safety | | | | | |
| ENG 403 | Technical Writing | | | | | |
| AC 210 | Principles: Industrial Accounting | | | | | |
| MGT 301 | Principles of Management | | | | | |
| LAW 301 | Principles of Law | | | | | |
| MKT 307 | Sales Administration | | | | | |
| MKT 413 | Industrial Marketing | | | | | |

| | | | | | **MOST** valuable Check 1 in group | **LEAST** valuable Check 1 in group |
|---|---|---|---|---|---|---|
| TC 113 | Intro to Information Processing | | | | | |
| TC 114 | Intro to Energy Processing | | | | | |
| TC 118 | Intro to Material Processing | | | | | |
| TC 121 | Technical Drafting | | | | | |
| TC 223 | DC Circuits | | | | | |
| TC 233 | AC Circuits | | | | | |
| TC 303 | Electro-Mechanical Converters | | | | | |
| TC 313 | Electrical Power Systems | | | | | |
| TC 323 | Analog Circuits | | | | | |
| TC 433 | Digital Circuits | | | | | |
| TC 443 | Electronic Communications | | | | | |
| TC 453 | Microprocessors | | | | | |

21. Did you transfer all, or all but one, of the electrical courses required to CCSU? _____ No _____ Yes
**If YES skip to question 25.** Please answer question 25a only and question 26.

22. How would you rate the Electrical Systems CURRICULUM at CCSU on the following items as a whole?
Please circle one number for each item.

| | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| Course objectives | 5 | 4 | 3 | 2 | 1 |
| Course topics | 5 | 4 | 3 | 2 | 1 |
| Depth of topics (detail) | 5 | 4 | 3 | 2 | 1 |
| Breadth of topics (range) | 5 | 4 | 3 | 2 | 1 |
| Sequence of courses | 5 | 4 | 3 | 2 | 1 |
| Appropriateness of laboratory exercises | 5 | 4 | 3 | 2 | 1 |
| Focus on applications | 5 | 4 | 3 | 2 | 1 |
| Math requirements | 5 | 4 | 3 | 2 | 1 |
| Connection of courses | 5 | 4 | 3 | 2 | 1 |

23. How would you rate the FACULTY in the Electrical Systems program at CCSU on the following items as a whole?
Please circle one number for each item.

| | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| Subject knowledge | 5 | 4 | 3 | 2 | 1 |
| Effectiveness of instruction style | 5 | 4 | 3 | 2 | 1 |
| Availability for assistance | 5 | 4 | 3 | 2 | 1 |
| Preparation | 5 | 4 | 3 | 2 | 1 |
| Organization of course | 5 | 4 | 3 | 2 | 1 |
| Grading standards | 5 | 4 | 3 | 2 | 1 |

24. How would you rate the FACILITIES used by the Electrical Systems program at CCSU on the following items as a whole?
Please circle one number for each item.

| | Excellent | Good | Average | Fair | Poor |
|---|---|---|---|---|---|
| Laboratory room size | 5 | 4 | 3 | 2 | 1 |
| Laboratory room arrangement | 5 | 4 | 3 | 2 | 1 |
| Laboratory equipment | 5 | 4 | 3 | 2 | 1 |
| Laboratory supplies | 5 | 4 | 3 | 2 | 1 |
| Laboratory availability | 5 | 4 | 3 | 2 | 1 |
| Computers | 5 | 4 | 3 | 2 | 1 |

If you transfer all, or all but one, of the electrical courses required to CCSU answer question 25a only and question 26.

25. The Industrial Technology Department has identified the following skills as learning objectives for the Electrical Systems Program. In this section you are asked to indicate three things for the skills listed:
    a. The IMPORTANCE of the skill in your career.
       The scale is 5 to 1 with 5 being very important and 1 being not important at all.
    b. Your proficiency in performing the skill BEFORE you started the Electrical Systems program.
       The scale is 3=advanced, 2=intermediate, 1=basic, 0=none
    c. Your proficiency in performing the skill AFTER you completed the Electrical Systems program
       The scale is 3=advanced, 2=intermediate, 1=basic, 0=none

| Please circle one number per skill in each column. | Importance<br>5-4-3-2-1<br>very.....not | Proficiency **Before**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None | Proficiency **After**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None |
|---|---|---|---|
| **DC Circuits** | | | |
| Determine current, resistance, voltage and power in DC circuits using Ohm's law, Kirchoff's laws, and power equation. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Build resistive DC circuits and take measurements of I, V, R. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Apply superposition, Thevenin's and maximum power transfer theorems to circuit analysis. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Explain principle of magnetic field, electromagnetism and electromagnetic induction. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe principle of operation of electromagnetic devices such as solenoids and relays. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe how a transformer is constructed and how it operates. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Verify voltage, turn ratio, and reflected resistance of transformers using basic laboratory equipment. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze inductive and capacitive DC circuits. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| **AC Circuits** | | | |
| Mathematically analyze a sinusoidal waveform. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Use phasors and complex numbers to represent a sine wave. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze series and parallel RC, RL, RLC circuits for voltage, current, and impedance. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze operation of low-pass, high-pass, band filters. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze circuits for resonance. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Build AC circuits using function generator as source. Measure characteristics of AC circuits using oscilloscope and DMM. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Measure frequency response of RC, RL, and RLC circuits. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |

| Please circle one response per item in each column. | Importance<br>5-4-3-2-1<br>very.....not | Proficiency **Before**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None | Proficiency **After**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None |
|---|---|---|---|
| **Electro-Mechanical Converters** | | | |
| Explain basic laws and relationships governing electro-mechanical energy conversion. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Explain transformer construction, operation, electromagnetic characteristics, troubleshooting, and repair. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe DC machine construction, physical characteristics, and electromagnetic analysis related to energy conversion. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe DC motor and generator operation, control, analysis, and selection. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Explain the design considerations and operating characteristics of AC Dynamos. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe the construction, operation, control, and selection of AC generators. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe the construction, operation, control, and selection of AC motors. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| **Electrical Power Systems** | | | |
| Identify components and subsystems of electrical power systems (lighting, feeders, starters, motor control devices, etc.). | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Read power system blueprint for commercial facility. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Estimate materials, labor, and permits required to wire a commercial building. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Build a DC motor and wire switches. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Isolate faults and conduct safety lockout/tagout procedures. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Demonstrate knowledge of the electrical power systems through the application of the National Electric Code. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| **Analog Circuits** | | | |
| Explain basic transistor characteristics. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Identify basic amplifier configurations. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Design amplifier circuits including biasing and coupling resistors. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Calculate voltage and current gain. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze audio amplifier circuits. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |

| Please circle one response per item in each column. | Importance<br>5-4-3-2-1<br>very.....not | Proficiency **Before**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None | Proficiency **After**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None |
|---|---|---|---|
| **Electronic Communication** | | | |
| Explain fundamentals of communications, including carrier generation, modulation, multiplexing, and demodulation. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Explain components and subsystems of electronic communication systems. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze communication circuits, including AM/FM, modulators, transmitter/receiver circuits, antennas and transmission lines. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Construct communication circuits. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Measure operating conditions of communication circuits using instrumentation. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| **Digital Circuits** | | | |
| Use and convert between decimal, binary, hexadecimal number systems. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Analyze combinatorial logic circuits using boolean algebra. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Design combinatorial circuits using Boolean algebra, truth tables, and Karnaugh maps. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Construct digital circuits using ICs. Measure logic levels using DMM to verify circuit outputs. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Trouble shoot circuits | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe function of basic building blocks of combinatorial logic circuits including multiplexer, decoder, adders, and displays. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Describe operation of sequential devices (flip flops) using timing diagrams and truth tables. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Design, draw, and construct counters and registers using flip flops and counter ICs. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| **Microprocessors** | | | |
| Describe the organization and operation of RAM and ROM. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Determine memory addressing from block diagrams. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Identify all internal components and I/Os of microprocessor. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Use the instruction set to write and execute programs. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |

| Please circle one response per item in each column. | Importance<br>5-4-3-2-1<br>very ..... not | Proficiency **Before**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None | Proficiency **After**<br>3 - 2 - 1 - 0<br>Adv Inter Basic None |
|---|---|---|---|
| Interface the microprocessor to simple I/O devices (LEDs and switches). | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Explain the interrupt process for microprocessor. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |
| Configure a programmable interface device (MUART) to handle simple I/O. | 5-4-3-2-1 | 3 - 2 - 1 - 0 | 3 - 2 - 1 - 0 |

26. Are there other topics, critical skills, competencies or knowledge not covered in the Industrial Technology Electrical Systems program that you think should be included in the curriculum? Please explain below.